Title

PRE-START ALARM AND COMMUNICATIONS SYSTEM TYPE PSACS1

USER'S MANUAL

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03

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1. GENERAL DESCRIPTION

The Austdac voice communications and pre-start alarm system (type PSACS1) is designed to be used with conveyors of all types where voice communications and pre-start alarm facilities are required along the entire length of the conveyor or belt. The voice communications subsystem allows crew to communicate with each other or communicate with a surface located control room, while the pre-start alarm subsystem provides an audible warning that the conveyor is about to start moving.

The various components of the system are located along the length of the conveyor to provide continuous audible coverage of the conveyor and associated plant. The controller is typically located at or within the conveyor control cubicle, the intercoms are placed at strategic locations along the conveyor and the tail end unit is located at the boot end of the belt.

The controller is responsible for interfacing with the conveyor control system, issuing the pre-start alarm, controlling the connection to the surface pair and distributing power to the other system components such as the intercoms and tail end unit.

Photograph 1. The components of the PSACS1 system

The intercoms with their sideways facing speakers are distributed along the conveyor to provide continuous audible pre-start alarm coverage as well as voice communications coverage. Crewmembers can instigate a conversation to other crew along the belt or contact the surface operator from any of the intercoms.

The tail end unit is located at the boot end of the conveyor and monitors the entire system for correct operation during a pre-start alarm. The tail end unit monitors the pre-start alarm and send s back a message to confirm that the alarm was heard along the entire length of the conveyor.

The inter-systems coupler can be placed in the centre of a long conveyor to allow the outbye intercoms to be powered from the controller and the inbye intercoms to be powered from a separate power supply at the boot end. This allows conveyors up to 8000 metres long to be protected with pre-start alarm facilities.

The DTMF keyboard can be co-located with any intercom to allow direct dialling into a PABX or analogue PSTN telephone line. The keyboard will allow direct half duplex telephone conversations between the conveyor and the surface.

2. SYSTEM LAYOUT – SCALEABLE ARCHITECTURE

The pre-start alarm and communications system can be implemented in several ways, starting with a pair of intercoms and a power supply ranging up to a fully optioned pre-start alarm system with telephone dialling and answering facilities.

Figure 1 shows the general system interconnection details for a fully optioned system. This figure shows the four wire interconnecting cable of the powered segment that forms the backbone of the Pre-start alarm and communications system type PSACS1.

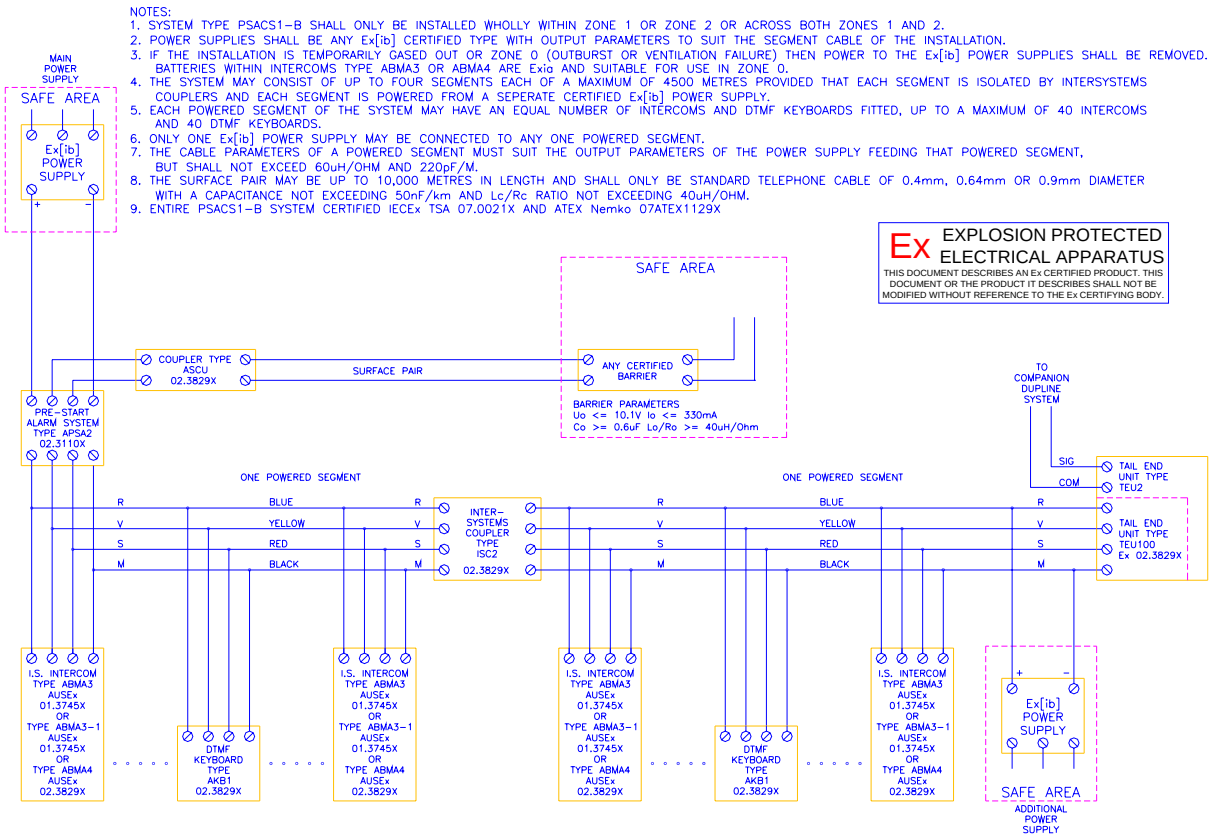

NOTES:
1. SYSTEM TYPE PSACS1-B SHALL ONLY BE INSTALLED WHOLLY WITHIN ZONE 1 OR ZONE 2 OR ACROSS BOTH ZONES 1 AND 2.
2. POWER SUPPLIES SHALL BE ANY Ex[ib] CERTIFIED TYPE WITH OUTPUT PARAMETERS TO SUIT THE SEGMENT CABLE OF THE INSTALLATION.
3. IF THE INSTALLATION IS TEMPORARILY GASED OUT OR ZONE 0 (OUTBURST OR VENTILATION FAILURE) THEN POWER TO THE Ex[ib] POWER SUPPLIES SHALL BE REMOVED. BATTERIES WITHIN INTERCOMS TYPE ABMA3 OR ABMA4 ARE Exia AND SUITABLE FOR USE IN ZONE 0.
4. THE SYSTEM MAY CONSIST OF UP TO FOUR SEGMENTS EACH OF A MAXIMUM OF 4500 METRES PROVIDED THAT EACH SEGMENT IS ISOLATED BY INTERSYSTEMS COUPLERS AND EACH SEGMENT IS POWERED FROM A SEPERATE CERTIFIED Ex[ib] POWER SUPPLY.
5. EACH POWERED SEGMENT OF THE SYSTEM MAY HAVE AN EQUAL NUMBER OF INTERCOMS AND DTMF KEYBOARDS FITTED, UP TO A MAXIMUM OF 40 INTERCOMS AND 40 DTMF KEYBOARDS.
6. ONLY ONE Ex[ib] POWER SUPPLY MAY BE CONNECTED TO ANY ONE POWERED SEGMENT.
7. THE CABLE PARAMETERS OF A POWERED SEGMENT MUST SUIT THE OUTPUT PARAMETERS OF THE POWER SUPPLY FEEDING THAT POWERED SEGMENT, BUT SHALL NOT EXCEED 60uH/OHM AND 220pF/M.
8. THE SURFACE PAIR MAY BE UP TO 10,000 METRES IN LENGTH AND SHALL ONLY BE STANDARD TELEPHONE CABLE OF 0.4mm, 0.64mm OR 0.9mm DIAMETER WITH A CAPACITANCE NOT EXCEEDING 50nF/km AND Lc/Rc RATIO NOT EXCEEDING 40uH/OHM.
9. ENTIRE PSACS1-B SYSTEM CERTIFIED IECEx TSA 07.0021X AND ATEX Nemko 07ATEX1129X
MAIN POWER SUPPLY
SAFE AREA
Ex[ib] POWER SUPPLY
EXPLOSION PROTECTED ELECTRICAL APPARATUS
THIS DOCUMENT DESCRIBES AN Ex CERTIFIED PRODUCT. THIS DOCUMENT OR THE PRODUCT IT DESCRIBES SHALL NOT BE MODIFIED WITHOUT REFERENCE TO THE Ex CERTIFYING BODY.
SAFE AREA
COUPLER TYPE ASCU 02.3829X
SURFACE PAIR
ANY CERTIFIED BARRIER
BARRIER PARAMETERS
Uo <= 10.1V Io <= 330mA
Co >= 0.6uF Lo/Ro >= 40uH/Ohm
PRE-START ALARM SYSTEM TYPE APSA2 02.3110X
TO COMPANION DUPLINE SYSTEM
SIG
COM
TAIL END UNIT TYPE TEU2
TAIL END UNIT TYPE TEU100 Ex 02.3829X
ONE POWERED SEGMENT
ONE POWERED SEGMENT
R
V
S
M
BLUE
YELLOW
RED
BLACK
INTER-SYSTEMS COUPLER TYPE ISC2 02.3829X
I.S. INTERCOM TYPE ABMA3 AUSEx 01.3745X OR TYPE ABMA3-1 AUSEx 01.3745X OR TYPE ABMA4 AUSEx 02.3829X
DTMF KEYBOARD TYPE AKB1 02.3829X
Ex[ib] POWER SUPPLY
SAFE AREA
ADDITIONAL POWER SUPPLY

Figure 1 Pre-start alarm and Communication system general system interconnection details

The simple communications system is useful in single entry type work, where a conveyor is not present, to provide simple and effective broadcast type communications over a large area. Any number up to forty intercoms can be connected in a communications only system with a single power supply. The intercom type ABMA3 is best suited for this application as it can generate local call tones without requiring a system controller. Figure 2 shows the simple stand-alone voice communications only system.

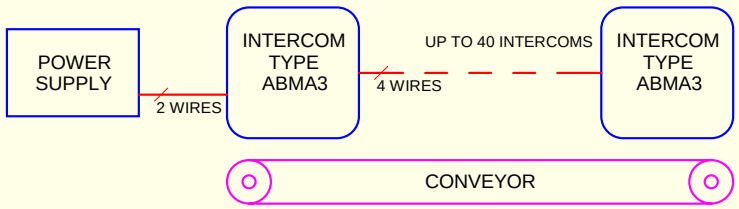


FIGURE 2. SIMPLE VOICE COMMUNICATIONS ONLY SYSTEM

Figure 3 below shows the simple communications system with a surface pair connection to a BMA exchange or surface located intercoms. This configuration allows communications along the length of the conveyor and with the surface or with another conveyor if patched through the surface exchange. The

surface exchange may be a hardware based BMA exchange or an Austdac computer based exchange. The intercom type ABMA3 is best suited for this application as it can generate local call and exchange call tones without requiring a system controller.

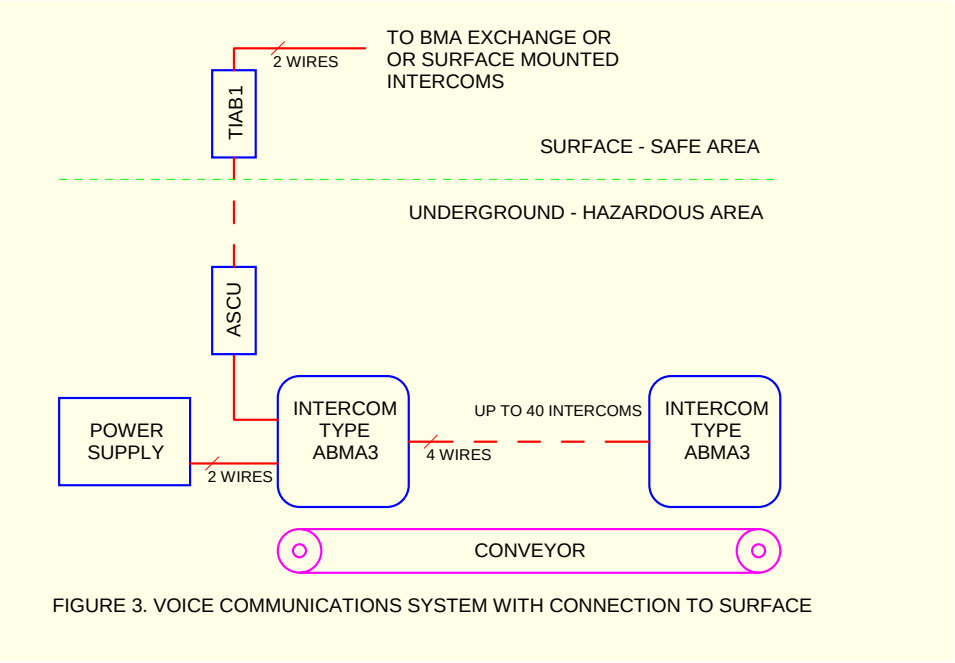


FIGURE 3. VOICE COMMUNICATIONS SYSTEM WITH CONNECTION TO SURFACE

The next configuration of the system, shown in figure 4 below, involves the addition of the pre-start alarm controller type APSA2 and the tail end unit type TEU100 to the intercom string along the conveyor. This adds the ability to issue an audible pre-start alarm along the entire length of the conveyor. The simple speech communications of the earlier configurations remain in this configuration to provide a full conveyor voice communications and pre-start alarm system. The intercom can be type ABMA3 or ABMA4 or a combination of both. The ABMA3 provides a simple operator interface while the ABMA4 provides an LCD and keypad interface for system monitoring and maintenance purposes. See sections 6 and 7 for a more detailed description of the intercoms and their capabilities.

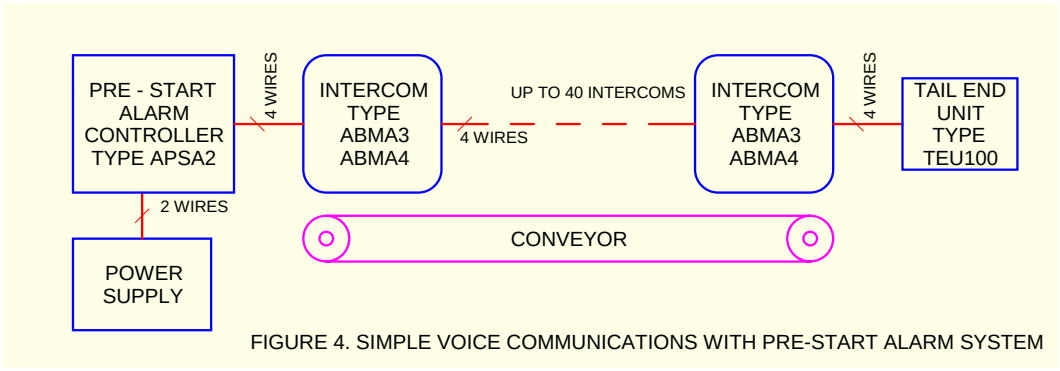


FIGURE 4. SIMPLE VOICE COMMUNICATIONS WITH PRE-START ALARM SYSTEM

The pre-start alarm and communications system can also be connected to the surface via the surface pair as indicated in earlier configurations. This configuration shown in figure 5 below represents the most frequently used configuration of the PSACS1 system. It provides voice communications and monitored pre-start alarm facilities along the entire length of the host conveyor.

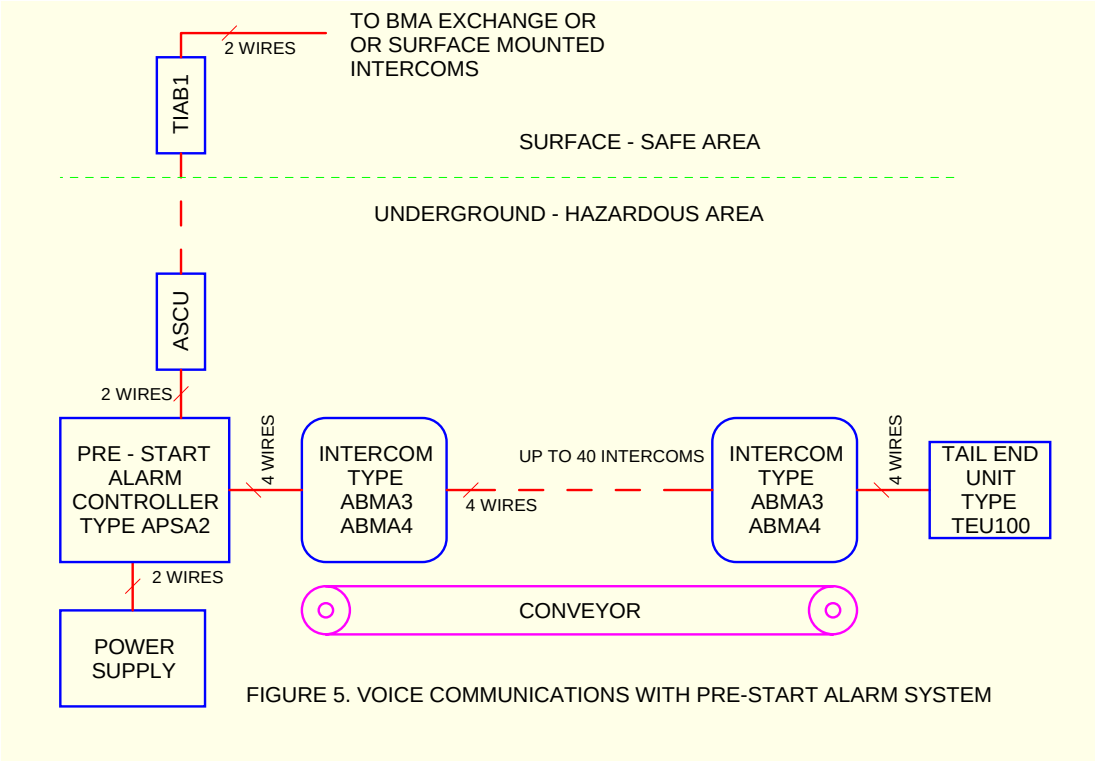


FIGURE 5. VOICE COMMUNICATIONS WITH PRE-START ALARM SYSTEM

Figure 6 shows the inter-system coupler type ISC2 that allows the addition of a boot end located power supply to allow a conveyor between 4000m and 8000m to be protected by a pre-start alarm and have voice communications along the entire length of the conveyor.

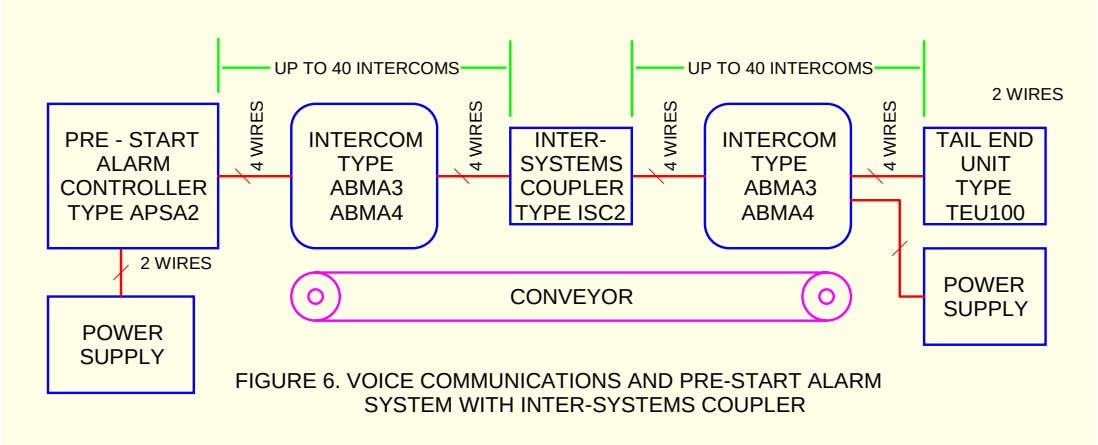


FIGURE 6. VOICE COMMUNICATIONS AND PRE-START ALARM SYSTEM WITH INTER-SYSTEMS COUPLER

The inter-systems coupler provides galvanic isolation between the two power supplies connected to the system. This preserves the explosion-protected properties of the PSACS1 system. The inter-systems coupler type ISC2 may be located anywhere within the general centre of the conveyor. The inter-systems coupler divides the PSACS1 system into two separately powered segments. The additional power supply may be located at the boot end of the conveyor or any convenient location in the inbye powered segment of the conveyor. Refer to section 10 of this document for a more detailed description of the inter-systems coupler.

Finally DTMF keyboards type AKB1 may be added to the intercom string to allow direct dialling via a telephone line connected via a surface located interface connected to the surface pair. This interface can be a TARA or an Austdac computer based exchange and PABX.

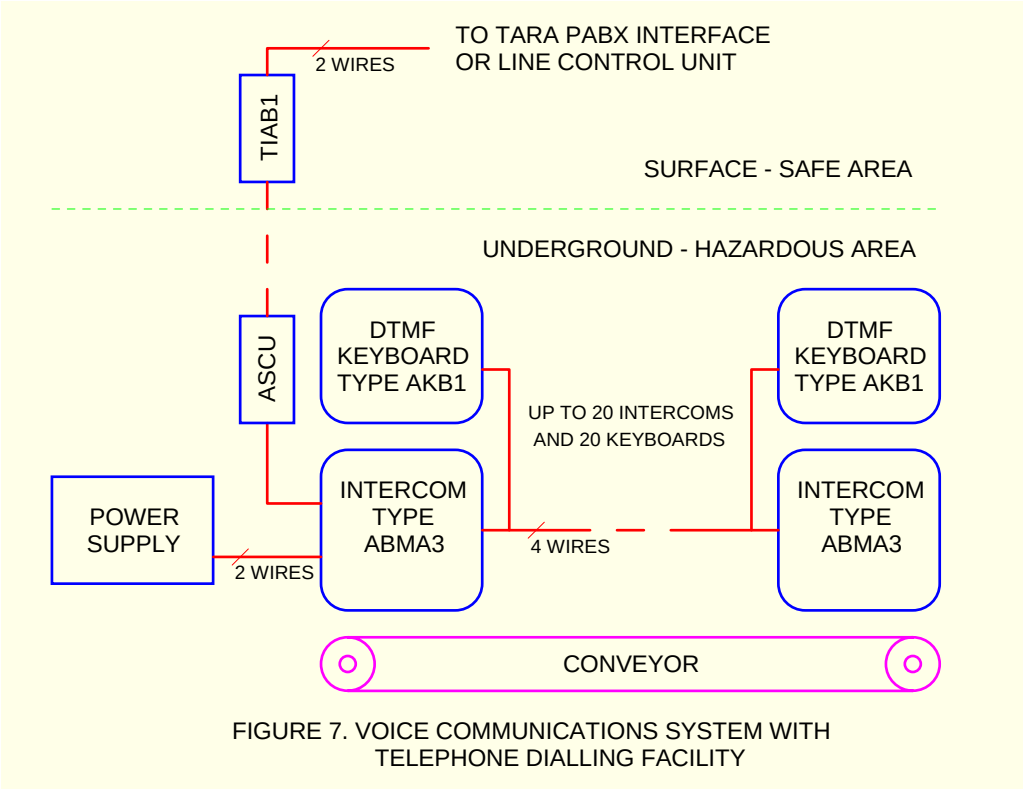


FIGURE 7. VOICE COMMUNICATIONS SYSTEM WITH TELEPHONE DIALLING FACILITY

This configuration with DTMF keypads type AKB1 allows telephone calls to be originated and answered from the PSACS1 system underground without surface operator intervention. An incoming phone call will broadcast ring tone along the entire length of the conveyor allowing the call to be answered from any type AKB1 keypad located along the conveyor. A phone call can be originated from any type AKB1 keypad by entering a code followed by the required phone number.

Configurations can be provided that answer incoming phone calls automatically and broadcast them along the conveyor belt without any type AKB1 keypads in the system. Other configurations can be provided that allow pre-allocated phone numbers to be stored in the phone line interface to allow quick and convenient connection to emergency, operations manager or other conveyors etc.

The PSACS1 pre-start alarm and communications system allows up to 40 intercoms per powered segment and up to two powered segments per system. Generally each powered segment can be up to 4000 metres long depending on system cable attenuation and voltage drop. A complete system functional assessment must be carried out on a proposed system layout to ensure that the required system will operate correctly. Austdac Pty Ltd can provide this assessment during your system design phase.

3. PRINCIPLE OF OPERATION

The pre-start alarm and communications system uses a four-wire system cable to provide power and signal paths for the entire system. The system cable has two large conductors for power and two small conductors for signal. The two power conductors provide power from the power supply to all the intercoms and other components distributed along the system cable.

PSACS1 SYSTEM CONDUCTOR NAMES AND FUNCTIONS				
NAME	SYMBOL	PRIMARY FUNCTION	SECONDARY FUNCTION	COLOUR
POSITIVE SUPPLY	R	POSITIVE SUPPLY	COMMON RETURN FOR VOICE AND SIGNAL LINES	BLUE
VOICE LINE	V	CONVEY BI-DIRECTIONAL VOICE OR TONES ALONG ENTIRE LENGTH OF SYSTEM	'CALL EXCHANGE' REQUEST LINE	YELLOW
SIGNAL LINE	S	CONVEY PRE-START ALARM CONFIRMATION TONES FROM THE TAIL END UNIT TO THE CONTROLLER	'LOCAL CALL' OR ATTENTION REQUEST LINE	RED
NEGATIVE SUPPLY	M	NEGATIVE SUPPLY	NONE	BLACK

Table 1 PSACS1 system conductor names and functions

The power supply is typically 12.6 volts DC. Table 1 shows the function and name of the conductors in the system backbone cable.

POSITIVE SUPPLY or R LINE
The positive supply line provides positive power from the power supply to all the components distributed along the system cable. The return for this supply is the negative supply line. The positive supply is typically 12 volts DC. The positive supply line is also the common for all tones and speech signals within the system.

VOICE LINE or V LINE
The voice line is primarily for conveying any voice or pre-start alarm signals along the entire length of the installation. The voice signal may originate from any intercom along the conveyor and would travel in both directions until it reaches the controller type APSA2, inter-systems coupler type ISC2 or the tail end unit type TEU100. The voice signal may also originate from the surface pair connected to the APSA2 controller. In this case the voice line would carry the voice signal from the controller towards the tail end unit.

The voice line can also transfer the pre-start alarm tones from the controller to all the intercoms and finally to the tail end unit. All voice or tone signals on the voice line are with respect to the positive supply line or R line.

The voice line may also be used by some legacy intercoms (BMAs type STAGE II) to request a “call exchange tone” from the controller, by changing the DC level of the voice line. The voice line normally sits at a DC voltage level between the system supply voltage and the supply voltage minus one volt. If the DC voltage level on the V line with respect to the R line is changed to a value greater than six volts, the pre-start alarm controller will issue a call exchange tone (400Hz) for about 4 seconds. This call exchange tone is transmitted to all intercoms and the surface exchange pair. This tone triggers a tone detector in the surface exchange that in turn rings an alarm to attract the exchange operator’s attention.

This multiplexing of the V line allows AC type voice or audio signals to be conveyed along the entire length of the system and DC type level signals to request a call exchange tone from the controller by pressing a button on any one of the BMAs. Once a call exchange tone has been requested all intercoms on the system will sound the tone until the controller has timed out.
The later model intercoms type ABMA3 and ABMA4 can be configured to request tones from the pre-start alarm controller to maintain backwards compatibility with BMAs type STAGE II or generate the tone internally using the intercom onboard battery. This later method has the advantage of functioning during mains power failures, as the pre-start alarm controller is not battery backed.

SIGNAL LINE or S LINE
The signal line is primarily for conveying pre-start alarm confirmation tones from the tail end unit to the pre-start alarm controller type APSA2. Whenever a pre-start alarm sounds along the length of the conveyor the tail end unit divides the pre-start alarm tone frequency by eight and returns it to the controller as a means of confirming that the pre-start alarm made it along the entire length of the conveyor. The controller looks for the returned lower frequency tones and energises the confirm relay signifying that the pre-start alarm was sounded along the entire length of the installation.

The S line may also be used by some legacy intercoms (BMAs type STAGE II) to request a “local call tone” from the controller, by changing the DC level of the signal line. The signal line normally sits at a DC voltage level between the system supply voltage and the supply voltage less one volt. If the DC voltage level on the S line with respect to the R line is changed to a value greater than six volts, the pre-start alarm controller will issue a local call tone (1200Hz) for as long as the local call button is pressed. A “local call tone” can be requested from any intercom or BMA along the length of the conveyor. The “local call tone” is used to attract attention of personnel along the conveyor. The “local call tone” is not passed to the surface pair and therefore will not attract the attention of the surface exchange operator.

This multiplexing of the S line allows AC type low frequency PSA confirmation signals to be conveyed from the tail end unit to the controller and DC type level signals to request a local call tone from the controller by pressing a button on any one of the BMAs. The local call tone will only sound while the local call button is pressed.
The later model intercoms type ABMA3 and ABMA4 can be configured to request tones from the pre-start alarm controller to maintain backwards compatibility with BMAs type STAGE II or generate the tone

internally using the intercom onboard battery. This later method has the advantage of functioning during mains power failures, as the pre-start alarm controller is not battery backed.

NEGATIVE SUPPLY or M LINE
Negative supply line provides the supply current return for the positive supply line. The negative supply line only has one function.

MONITORED PRE-START ALARM
The pre-start alarm is monitored to ensure that the pre-start alarm tones reach the entire length of the conveyor installation. For a pre-start alarm to be confirmed or successful it must make its way from the controller through all the intercoms or BMAs, that sound the pre-start alarm and onto the tail end unit. The tail end unit detects the pre-start alarm tones and returns a confirmation set of tones to the controller so that a confirmation or successful signal can be passed onto the host PLC or conveyor controller. Figure 8 shows where all the signals, speech, tones and power go in a typical installation.

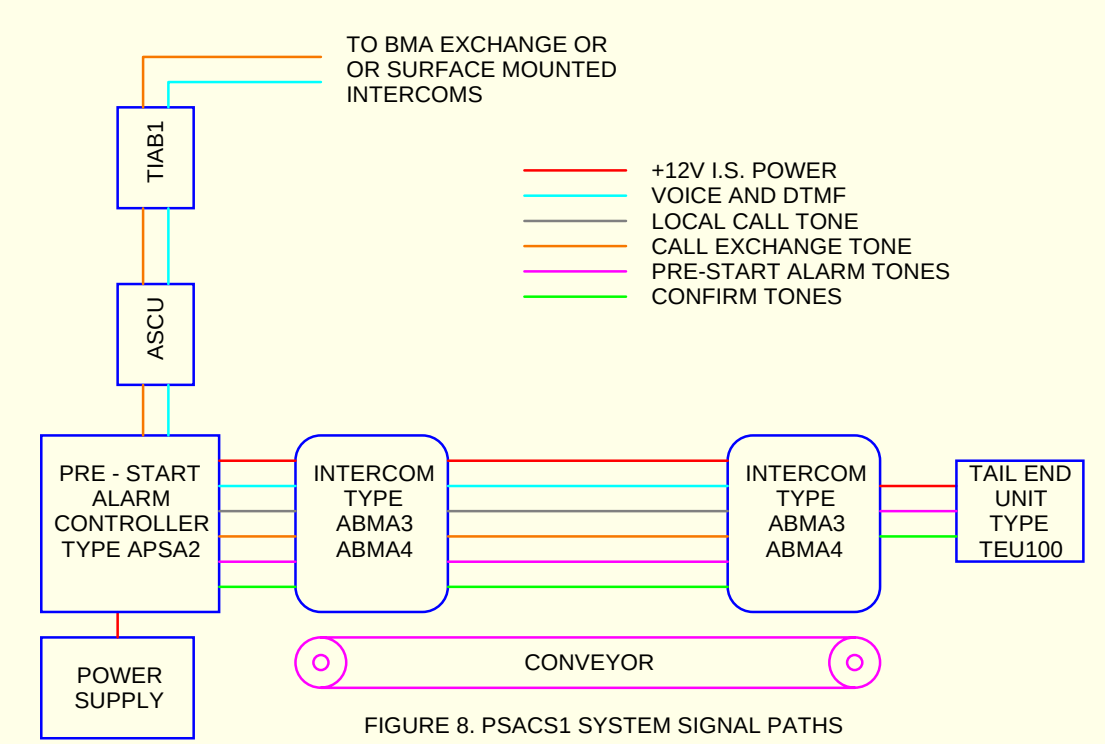


FIGURE 8. PSACS1 SYSTEM SIGNAL PATHS

PRE-START ALARM TONE FREQUENCIES
The pre-start alarm tones are a HEE HAW type sound designed to attract maximum attention of workers along the entire length of the protected conveyor. Different pre-start alarm tone sets are available so that when one conveyor is near another, the starting conveyor can be determined from the tones. The tail end unit simply divides the pre-start alarm tones by eight and returns them to the controller for detection and the subsequent generation of the confirm signal. Table 2 lists the typical tone sets and their application.

PSACS1 PRE-START ALARM SYSTEM TONE SETS							
SET	PRE-START TONES			CONFIRMATION TONES			APSA2 SOURCE CODE WHERE X = VERSION
	HIGH	LOW	CADENCE	HIGH	LOW	CADENCE	
1	1800Hz	1500Hz	0.4S	225Hz	187.5Hz	0.4S	PSAMON**0**X.ASM
2	1700Hz	1400Hz	0.2S	212.5Hz	175Hz	0.2S	PSAMON**1**X.ASM
3	1900Hz	1300Hz	0.8S	237.5Hz	162.5Hz	0.8S	PSAMON**2**X.ASM

Table 2 PSACS1 Pre-start alarm tone sets

4. SYSTEM CABLE

The system cable forms an important part of the pre-start alarm and communications system type PSACS1. It carries all the signals and distributes power to all the system components. The system cable basically consists of four conductors within one outer sheath. Of the conductors two are larger in cross sectional area than the other two. The two larger cross sectional area conductors are used to distribute power to the system components while the smaller conductors are used to convey signals between the various system components.

PSACS1 SYSTEM CABLE TYPES AND INFORMATION							
CONDUCTOR TYPE	FUNCTION SYMBOL	CABLE – CABL25		CABLE – G2000		CABLE – G2000B	
		CSA mm^2	IDENT	CSA mm^2	COLOUR	CSA mm^2	COLOUR
POWER	R - BLUE	2.5	1	4.0	RED	4.0	BLUE
SIGNAL	V - YELLOW	2.5	3	1.0	WHITE	1.0	YELLOW
SIGNAL	S - RED	2.5	5	1.0	GREEN	1.0	RED
POWER	M - BLACK	2.5	2	4.0	BLACK	4.0	BLACK
SPARE	-	2.5	4	-	-	-	-

Table 3 PSACS1 typical system cable details

5. PRE-START ALARM CONTROLLER TYPE APSA2

The pre-start alarm controller type APSA2 forms the central part of the PSACS1 system when pre-start alarm facilities are required. It provides a connection point between the power supply, the intercom string, the surface pair and the host belt controller or PLC.

Photograph 2 Pre-start alarm controller type APSA2 front view

The pre-start alarm controller is housed within a plastic enclosure measuring 150mm x 150mm x 65mm. The front cover of the enclosure is clear allowing a clear view of the internal switch settings and LED indicators.

The pre-start alarm controller has two LED indicators, one green LED (LD1) flashes continuously to indicate system powered up and functioning, the other green LED (LD2) is illuminated whenever the confirm signal is asserted.

All eight switches of SW1 must be in the off position. SW2 controls the threshold level of the local call detect circuit. Only one switch of SW2 shall be on at any one time. The switch that must be on is selected by testing the local call buttons on an intercom at each end of the conveyor. The correct switch setting is the one that provides the most reliable start to a local call tone and the local call tone that is not modulated or "motorboating"

The primary responsibility of the PSA controller is the sounding of the pre-start alarm when requested, monitoring the return pre-start signal from the tail end unit, issuing the confirmation (contact closure) and controlling the throughput of tones to the surface pair. The secondary responsibility is the detection of DC level shifts on the voice and signal lines with respect to the R power supply line and the subsequent generation of call exchange and local call tones respectively.

Table 4 below shows the connection details to the pre-start alarm controller type APSA2.

PRE-START ALARM CONTROLLER TYPE APSA2 TERMINATION DETAILS		
PIN	NAME	FUNCTION – TERMINATION DETAIL
1	SCUD+	Balanced twisted surface pair VF communications port. Must be connected to the surface pair via a coupler type ASCU.
2	SCUD-	
3	R	Positive power connection intercom string and tail end unit
4	V	Voice line connection intercom string and tail end unit
5	S	Signal line connection intercom string and tail end unit
6	M	Negative power connection intercom string and tail end unit
7	I.S. PSA REQUEST	Intrinsically safe pre-start alarm request input. Requires a voltage free contact closure to initiate a pre-start alarm.
8	I.S. PSA REQUEST	
9	PWR +	Positive power input for system from power supply
10	PWR -	Negative power input for system from power supply
11	CONFIRM COM	Confirm relay changeover contact set 1. Relay is energised on valid confirmation of pre-start alarm.
12	CONFIRM N/C	
13	CONFIRM N/O	
14	CONFIRM COM	Confirm relay changeover contact set 2. Relay is energised on valid confirmation of pre-start alarm.
15	CONFIRM N/C	
16	CONFIRM N/O	
17	PSA REQUEST +24V	Non-intrinsically safe pre-start alarm request input. Requires application of 24 volts to initiate pre-start alarm. Um = 250V
18	PSA REQUEST –24V	

Table 4. Pre-start alarm controller type APSA2 termination details.

PRE-START ALARM INTERFACE

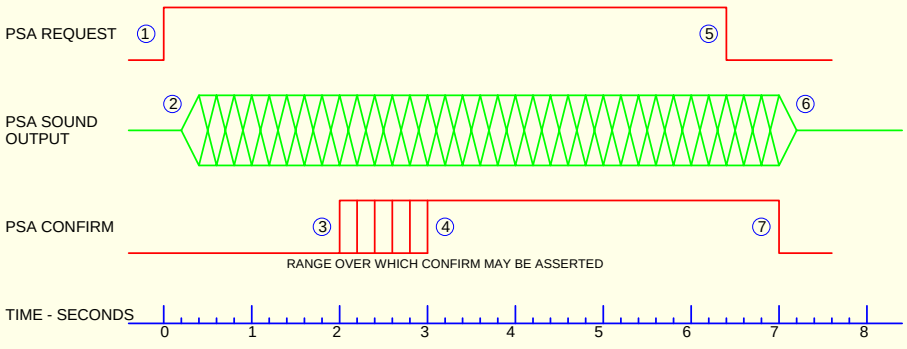
The pre-start alarm interface consists of one input and one output from the APSA2 controller. The input is the pre-start alarm request and the output is the pre-start alarm-confirm relay contact. The pre-start alarm interface allows the host PLC to request that a pre-start alarm be sounded along the conveyor and to determine if the pre-start alarm was valid.

The controller type APSA actually has two pre-start alarm request inputs, a intrinsically safe request input and a non-intrinsically safe request input, but only one is ever used in any one installation. The intrinsically safe request input requires a contact closure to initiate a pre-start alarm. The non-intrinsically safe request input requires the application of 24V DC to initiate a pre-start alarm.

The host PLC should assert the pre-start alarm request input whenever a pre-start alarm is required. The host PLC should continue to assert the request until one of the following has occurred:

- A confirmation has been received via the pre-start alarm confirm contact.
- No response of any kind within 35 seconds of asserting the request.

The pre-start alarm-confirm output is a voltage free changeover contact that is asserted whenever a pre-start alarm is successful. A successful pre-start alarm is one that has been confirmed by the tail end unit type TEU100. The confirmation will not be asserted if the system cable is damaged, open circuit, short circuit or if the tail end unit supply voltage is out of tolerance or if the pre-start request is negated prematurely.



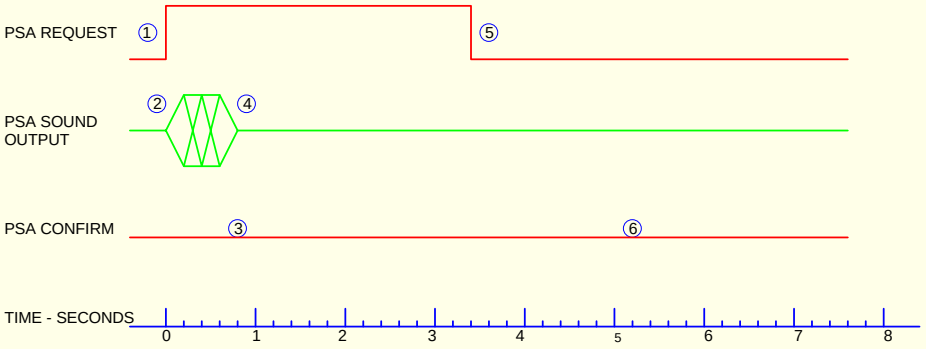
1. PRE-START REQUEST ASSERTED BY HOST PLC
2. PRE-START ALARM SOUND BEGINS
3. PSA CONFIRMED BY CONTROLLER (EARLIEST)
4. PSA CONFIRMED BY CONTROLLER (LATEST)
5. PRE-START REQUEST NEGATED BY HOST PLC
6. PRE-START ALARM SOUND ENDS
7. PSA CONFIRM NEGATED BY CONTROLLER

FIGURE 9 PRE-START ALARM (SUCCESSFUL) INTERFACE TIMING DIAGRAM

Figure 9 above shows a timing diagram for a successful pre-start alarm sequence. The sequence is started by the host PLC requesting a pre-start alarm. Assuming that the intercom string and tail end unit have no cable faults the controller type APSA2 will issue (assert) a confirm signal within two seconds.

It is important that the host PLC does NOT negate its request for a pre-start alarm during this delay period.

The pre-start alarm will continue to sound as long as the request is asserted. The request should remain until a confirmation is received from the controller. The shortest time between the request and the receipt of the confirmation is 10 seconds. The request can be negated any time after the receipt of the confirmation. If a longer pre-start alarm is required then the request should remain asserted for the required time. Once the request has been negated the sounding of the alarm will cease within one second. The controller will negate the confirm output within one second of the request being removed.



1. PRE-START REQUEST ASSERTED BY HOST PLC
2. PRE-START ALARM SOUND BEGINS
3. PSA CONFIRM IS NOT ASSERTED
4. PRE-START ALARM SOUND ENDS
5. PRE-START REQUEST NEGATED BY HOST PLC

FIGURE 10 PRE-START ALARM (FAIL) INTERFACE TIMING DIAGRAM

Figure 10 above shows a failed pre-start alarm sequence where the fault output was asserted three seconds after the request was issued. The host PLC should remove the request after the receipt of a fault. The host may have several attempts before raising an alarm.

For extended pre-start alarm sounding periods the host PLC should continue to monitor the confirm and fault outputs to ensure that the pre-start alarm functioned correctly for the entire period. It is possible for the pre-start alarm to initially function, issue a confirmation and then malfunction during the later part of the sounding period prior to the request being removed.

The pre-start alarm request will immediately override any sounds being broadcast via the sound card input or synthesiser input. The broadcasting of these sounds will resume three seconds after the request for the pre-start alarm has been removed.

It is important that the end user or overall system designer conduct a risk analysis on the time it takes staff to move away from the plant that is about to be started. The analysis should determine the longest exit time and ensure that the pre-start alarm sounds for that time period before any command to start is issued to the plant.

6. INTERCOM TYPE ABMA3

The intercom type ABMA3 provides the audio communications and pre-start alarm sounding facilities of the PSACS1 system. Intercoms are distributed along the conveyor at fixed distances apart to provide complete sound coverage along the conveyor. During a pre-start sequence the intercom sounds the pre-start alarm through its two sideways facing speakers. These same speakers and the front panel mounted microphone are used to carry out a half duplex voice conversation with other intercoms on the conveyor or a surface located BMA exchange operator. Photograph 3 below shows the front panel of a type ABMA3 intercom.

Photograph 3 Intercom type ABMA3 front view

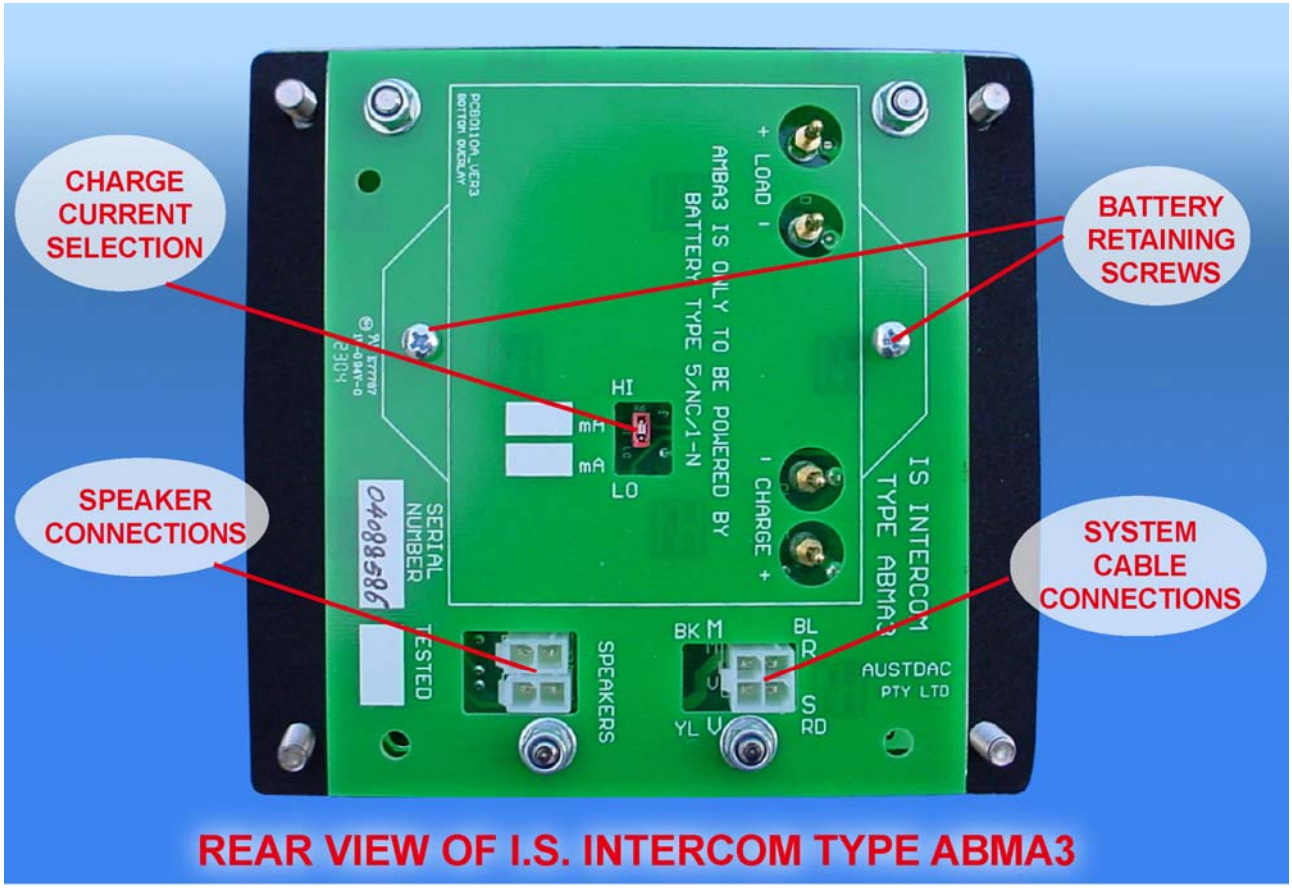
The intercom type ABMA3 has three front panel mounted push buttons, a front panel microphone and two side-mounted speakers to provide the voice communications interface for staff working along the conveyor belt.

A conversation with another worker along the conveyor belt can be initiated by pressing the local call button once or several times. The local call button is used to signal or attract the attention of workers along the conveyor. The local call button can be pressed and released to sound a series of beeps along the conveyor. The patterns and meaning of these beeps can be used to transmit messages to others along the belt.

The call exchange button is pressed to attract the attention of the BMA exchange operator at the surface. Once the operator has acknowledged the call further instructions, such as patching requests can be given from the intercom.

The voice communications of the PSACS1 system is half duplex i.e. only one party can speak at a time. The speak button of the intercom must be pressed whenever the user wishes to speak. It is important to get used to pressing the speak button just before speaking and releasing it just after finishing speaking. Failure to control the speak button correctly will result in the beginning or end of a statement being cut off.

The ABMA3 intercom when connected to the system cable will continually charge its rear mounted battery type 5/NC/1-N so that the intercom will have sufficient energy to sound a pre-start alarm or broadcast a conversation.



Photograph 4. Intercom type ABMA3 rear view

The above photograph shows the rear of the ABMA3 intercom with its battery removed to expose the battery charge current select jumper. In the LO position the battery charge current is 11mA and 22mA in the HI position. Refer to the system drawing for the correct charge rate for your intercoms. Generally the HI position is used in systems with short powered segments and fewer intercoms, the LO position is used in long powered segments with more intercoms.

Photograph 5. Battery type 5/NC/1-N side view

7. INTERCOM TYPE ABMA3-1

The intercom type ABMA3 provides the audio communications and pre-start alarm sounding facilities of the PSACS1 system. Intercoms are distributed along the conveyor at fixed distances apart to provide complete sound coverage along the conveyor. During a pre-start sequence the intercom sounds the pre-start alarm through its two sideways facing speakers. These same speakers and the front panel mounted microphone are used to carry out a half duplex voice conversation with other intercoms on the conveyor or a surface located BMA exchange operator. Photograph 3 below shows the front panel of a type ABMA3 intercom.

Photograph 6. Intercom type ABMA3-1 with 5/NH/1-N battery

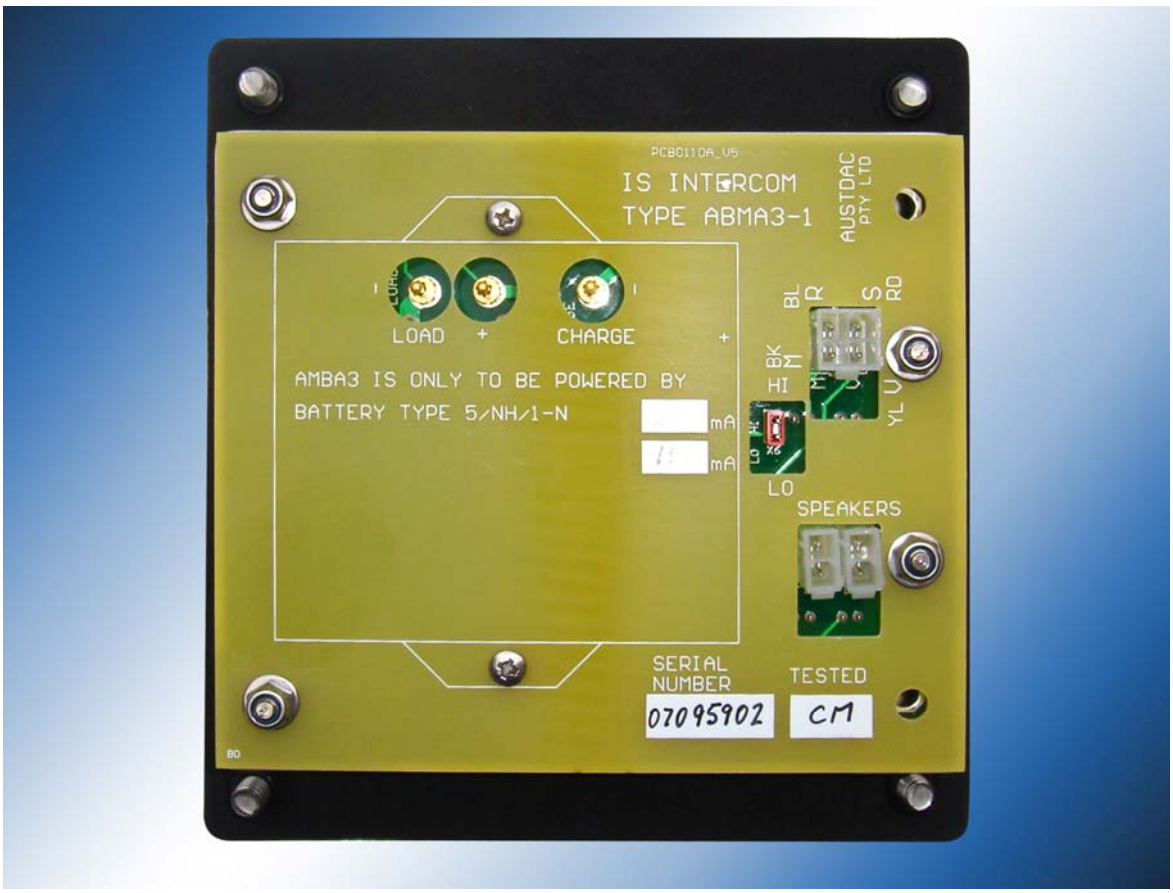
The intercom type ABMA3 has three front panel mounted push buttons, a front panel microphone and two side-mounted speakers to provide the voice communications interface for staff working along the conveyor belt.

A conversation with another worker along the conveyor belt can be initiated by pressing the local call button once or several times. The local call button is used to signal or attract the attention of workers along the conveyor. The local call button can be pressed and released to sound a series of beeps along the conveyor. The patterns and meaning of these beeps can be used to transmit messages to others along the belt.

The call exchange button is pressed to attract the attention of the BMA exchange operator at the surface. Once the operator has acknowledged the call further instructions, such as patching requests can be given from the intercom.

The voice communications of the PSACS1 system is half duplex i.e. only one party can speak at a time. The speak button of the intercom must be pressed whenever the user wishes to speak. It is important to get used to pressing the speak button just before speaking and releasing it just after finishing speaking. Failure to control the speak button correctly will result in the beginning or end of a statement being cut off.

The ABMA3 intercom when connected to the system cable will continually charge its rear mounted battery type 5/NH/1-N so that the intercom will have sufficient energy to sound a pre-start alarm or broadcast a conversation.



Photograph 7. Intercom type ABMA3-1 rear view.

The above photograph shows the rear of the ABMA3 intercom with its battery removed to expose the battery charge current select jumper. In the LO position the battery charge current is 11mA and 22mA in the HI position. Refer to the system drawing for the correct charge rate for your intercoms. Generally the HI position is used in systems with short powered segments and fewer intercoms, the LO position is used in long powered segments with more intercoms.

Photograph 8. Battery type 5/NH/1-N side view.

8. INTERCOM TYPE ABMA4

The intercom type ABMA4 provides the audio communications and pre-start alarm sounding facilities of the PSACS1 system. Intercoms are distributed along the conveyor at fixed distances apart to provide complete sound coverage along the conveyor. During a pre-start sequence the intercom sounds the pre-start alarm through its two sideways facing speakers. These same speakers and the front panel mounted microphone are used to carry out a half duplex voice conversation with other intercoms on the conveyor or a surface located BMA exchange operator. Photograph 4 below shows the front panel of a type ABMA4 intercom.

Photograph 9. Intercom type ABMA4 front view.

The intercom type ABMA4 has seven front panel mounted push buttons, a front panel microphone, an LCD display and two side-mounted speakers to provide the voice communications interface for staff working along the conveyor belt. The LCD display allows the operator to view operational and maintenance information about the intercom and the PSACS1 system.

A conversation with another worker along the conveyor belt can be initiated by pressing the local call button once or several times. The local call button is used to signal or attract the attention of workers along the conveyor. The local call button can be pressed and released to sound a series of beeps along the conveyor. The patterns and meaning of these beeps can be used to transmit messages to others along the belt.

The call exchange button is pressed to attract the attention of the BMA exchange operator at the surface. Once the operator has acknowledged the call further instructions, such as patching requests can be given from the intercom.

The voice communications of the PSACS1 system is half duplex i.e. only one party can speak at a time. The speak button of the intercom must be pressed whenever the user wishes to speak. It is important to

get used to pressing the speak button just before speaking and releasing it just after finishing speaking. Failure to control the speak button correctly will result in the beginning or end of a statement being cut off.

The ABMA4 intercom when connected to the system cable will continually charge its rear mounted battery type 5/NH/1-N so that the intercom will have sufficient energy to sound a pre-start alarm or broadcast a conversation. The ABMA4 uses the same battery as the ABMA3-1.

The rear of the ABMA4 intercom has a two-position battery charge current selection switch. In the LO position the battery charge current is 11mA and 22mA in the HI position. Refer to the system drawing for the correct charge rate for your intercoms. Generally the HI position is used in systems with short powered segments and fewer intercoms, the LO position is used in long powered segments with more intercoms.

Photograph 10. Intercom type ABMA4 rear view.

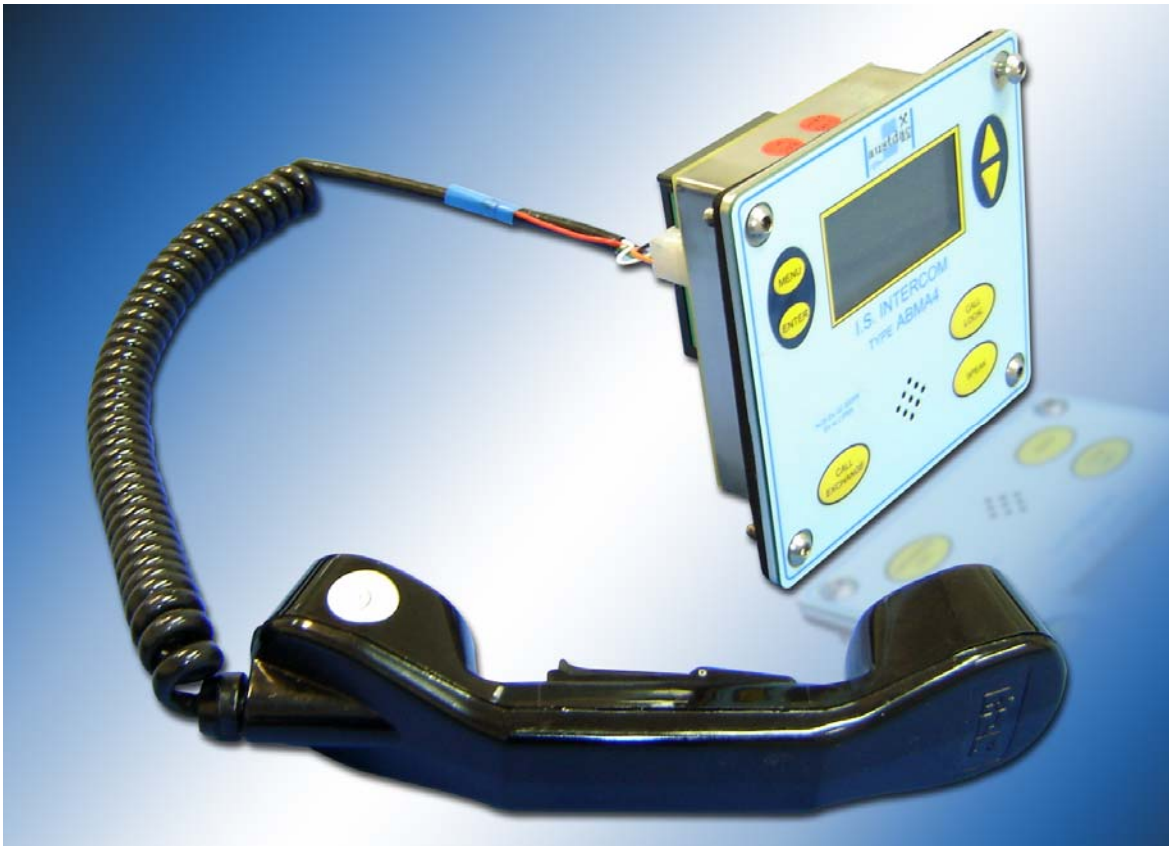
For more detail refer to the individual manual on the ABMA4 intercom.

9. INTERCOM TYPE ABMA4 + HANDSET

The intercom ABMA4 with handset fitted functions in a similar manner to the normal ABMA4 except that all voice communications are conducted through a handset. The communications is still half duplex and is still over a party line with no privacy within the intercom string. The handset allows the intercom to be used in an office or area where loud paging style communications is not appropriate. As an additional degree of flexibility the two side facing loud speakers can remain in circuit or can be disabled depending on the actual application.

The press to talk function is carried out by pressing the switch mounted in the grip section of the handset. The front panel mounted microphone and “speak” button are disabled whenever the handset is connected to the intercom type ABMA4. The display and other controls still function as in the standalone ABMA4. The two side mounted speakers will also broadcast whatever is received from line unless they are optionally disabled.

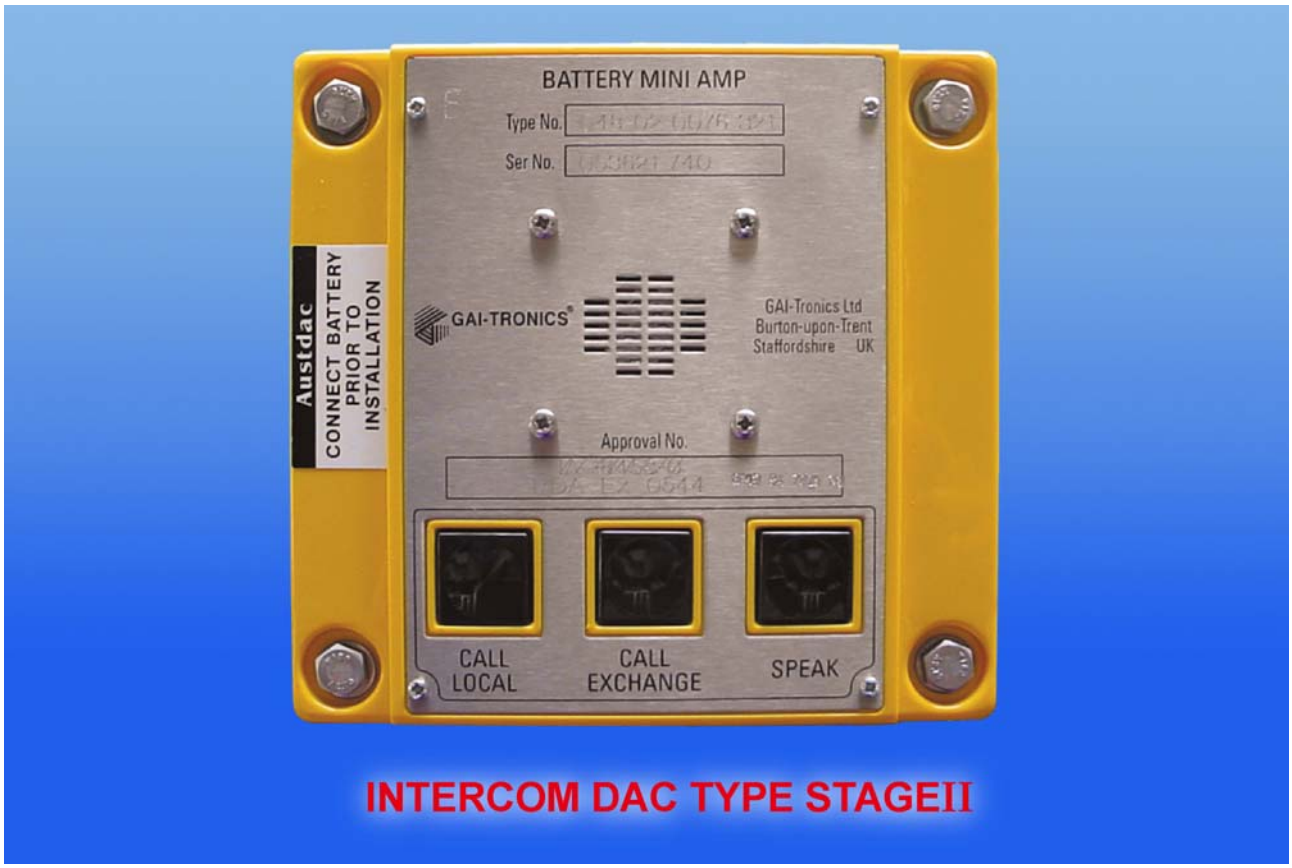
Photograph 11. Intercom type ABMA4 with handset attached



Photograph 12. Intercom type ABMA4 interior with handset (ready for control panel installation)

10. LEGACY INTERCOMS DAC TYPE STAGE II

Some earlier PSACS1 systems may be fitted with DAC type stage II battery mini amplifiers. These intercoms will only function fully when they are connected to a system with a type APSA2 controller. The stage II intercom will loose some functionality when power to the APSA2 controller is lost.



Photograph 13. Intercom DAC type stage II front view

For more detail refer to the individual manual on the DAC stage II intercom.

11. TAIL END UNIT TYPE TEU100

The tail end unit type TEU100 as the name implies is situated at the boot end of the conveyor with the sole purpose of monitoring the pre-start alarm tones on the V line from the controller at the drive head. If a valid pre-start alarm tone is received from the controller the tail end unit will divide this tone frequency by eight and return the new lower tone back to the controller via the S line. This process of modifying the pre-start tone and returning it to the controller allows the controller to verify that the pre-start alarm tone did reach the boot end of the conveyor.

Photograph 14. Tail end unit type TEU100 front view.

TAIL END UNIT TYPE TEU100 TERMINATION DETAILS			
CONN/PIN	NAME	COLOUR	FUNCTION
X1-1	R	BLUE	POSITIVE POWER SUPPLY INPUT 12.6 – 9 VOLTS
X1-2	V	YELLOW	VOICE LINE INPUT TO TONE DETECTOR
X1-3	S	RED	S LINE OUTPUT FROM TONE DIVIDER / TRANSMITTER
X1-4	M	BLACK	NEGATIVE POWER SUPPLY INPUT

Table 5. Tail end unit type TEU100 termination details.

12. TAIL END UNIT TEU2

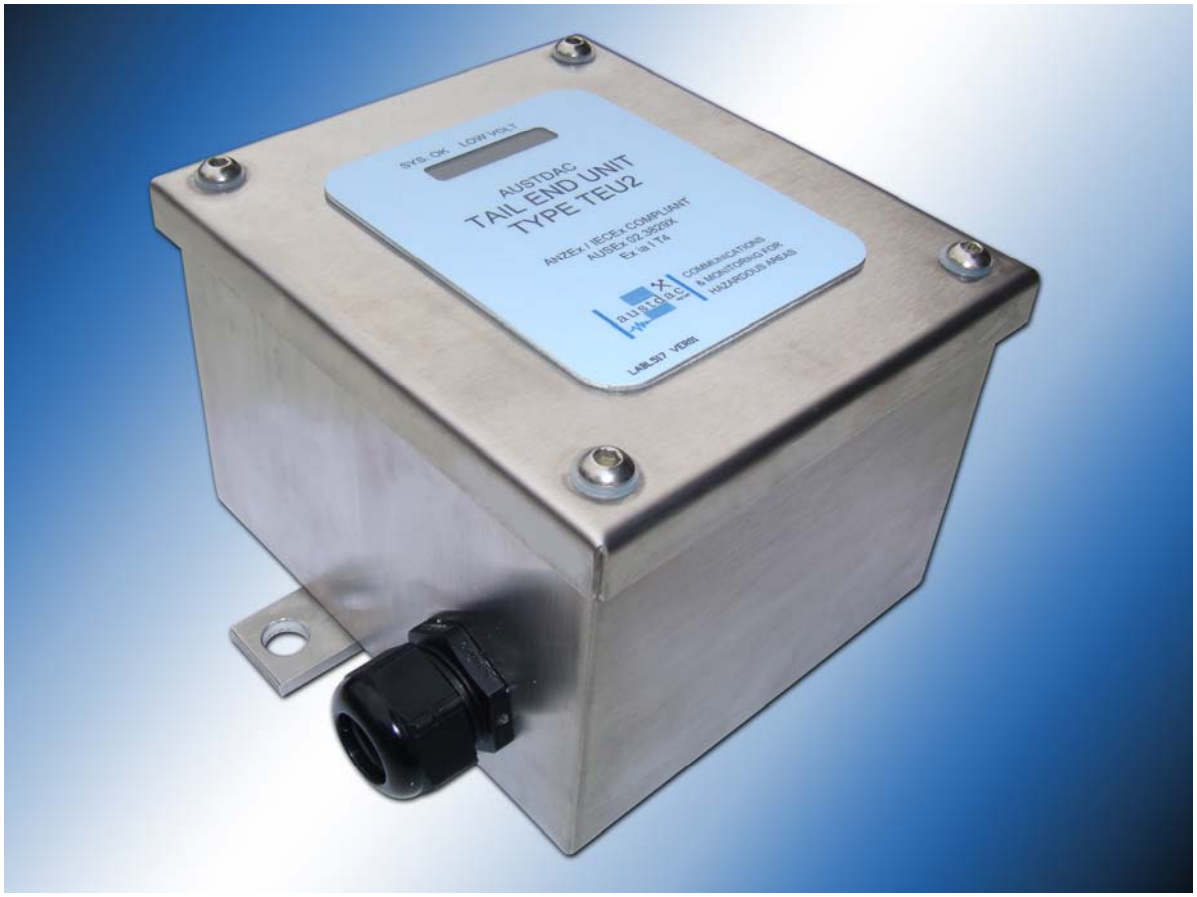
The tail end unit type TEU2 as the name implies is situated at the boot end of the conveyor with the sole purpose of monitoring the pre-start alarm tones on the V line from the controller at the drive head. If a valid pre-start alarm tone is received from the controller the tail end unit will divide this tone frequency by eight and return the new lower tone back to the controller via the S line. This process of modifying the pre-start tone and returning it to the controller allows the controller to verify that the pre-start alarm tone did reach the boot end of the conveyor. The TEU2 has two additional functions as follows:

- Provide a pre-start alarm detected (confirm) output that can be used to drive a Dupline field bus standard single channel digital transmitter or a safety transmitter. This feature can be used to monitor the pre-start alarm signal via an alternate return path.
- Provide a pre-start alarm system end of line under-voltage detected output that can be used to drive a Dupline field bus standard single channel digital transmitter or a safety transmitter. This feature can be used to continuously monitor the integrity of the pre-start alarm hardware and cabling instead of just during a pre-start alarm.

The TEU2 printed circuit board is fitted with connectors, terminals and switches allowing the unit to be configured as required. Table x below shows the various configuration options.

TAIL END UNIT TYPE TEU2 CONNECTOR ASSIGNMENTS		
CCT REF	FOR THE CONNECTION OF	SW1 / SW2 POSITION
X1	PRE-START ALARM SYSTEM R-V-S-M	---
TB1	DUPLINE FIELDBUS SIG-COM	---
X2	CONFIRM 8023 OR SILBUS8161 1CH DIG TX ONLY	SW1 in 8023 position
X3	EOL UNDER-VOLTAGE 8023 OR SILBUS8150 1CH DIG TX ONLY	SW2 in 8023 position
X4	CONFIRM SILBUS8150 SAFETY TX ONLY	SW1 in 8150 position
X5	EOL UNDER-VOLTAGE SILBUS8150 SAFETY TX ONLY	SW2 in 8150 position

Table 6. Configuration of tail end unit type TEU2



Photograph 15 Tail end unit type TEU2 side view

13. INTER-SYSTEMS COUPLER TYPE ISC2

The inter-systems coupler type ISC2 can be used to divide the intercom string into two segments, with each segment having up to 40 intercoms and DTMF keypads. This allows conveyors up to 6000 metres long to be protected by the pre-start alarm system. An additional power supply is required to power the boot end powered segment.

Photograph 16. Inter-systems coupler type ISC2 top view.

The inter-systems coupler should generally be placed in the centre of the intercom string. The inter-systems coupler does not require large amounts of power so the two powered segments that it separates can be powered from the extreme ends of the conveyor where power is generally available. Photograph ? shows the inter-systems coupler in its enclosure. The inter-systems coupler type ISC2 is provided with two gland entries one on each side of the enclosure.

The inter-systems coupler type ISC2 has two ports; one port for connection to the controller (out bye) powered segment, the other port is for connection to the boot end (in bye) powered segment. The two ports are not the same so the inter-systems coupler must be connected into the intercom string the correct way.

INTER-SYSTEMS COUPLER TYPE ISC2 TERMINATION DETAILS					
CONTROLLER SIDE POWERED SEGMENT - 2			TAIL END UNIT SIDE POWERED SEGMENT - 1		
SYMBOL	CONN / PIN	COLOUR	SYMBOL	CONN / PIN	COLOUR
R2	X4/1	BLUE	R1	X1/1	BLUE
M2	X4/2	BLACK	M1	X1/2	BLACK
V2	X3/1	YELLOW	V1	X2/1	YELLOW
S2	X3/2	RED	S1	X2/2	RED
SCRN2	X3/3	DRAIN	SCRN1	X2/3	DRAIN

Table 7. Inter-systems coupler type ISC2 termination details.

The inter-systems coupler type ISC2 has four LED indications to aid in system commissioning and fault finding. The first LED indicates power status on the controller side powered segment; the second indicates power status on the tail end unit side powered segment. The third and fourth LEDs provide indication of a call exchange or local call request in the boot end segment respectively.

INTER-SYSTEMS COUPLER TYPE ISC2 LED INDICATOR DETAILS			
REF	NAME	COLOUR	FUNCTION - INDICATION
LD1	V2 POWER	GREEN	CONTROLLER SIDE POWERED SEGMENT POWER AVAILABLE
LD2	V1 POWER	GREEN	TAIL END UNIT SIDE POWERED SEGMENT POWER AVAILABLE
LD3	LOCAL CALL	RED	LOCAL CALL REQUEST (BUTTON PRESED) DETECTED IN TAIL END UNIT POWERED SEGMENT
LD4	CALL EXCHANGE	YELLOW	CALL EXCHANGE REQUEST (BUTTON PRESSED) DETECTED IN TAIL END UNIT POWERED SEGMENT

Table 8. Inter-systems coupler type ISC2 LED indicator details.

14. DTMF KEYBOARD TYPE AKB1

The DTMF keyboard type AKB1 can be used to dial telephone numbers via an interface located in the safe area at the end of the surface pair. The keyboard is typically co-located with an intercom to provide a complete half-duplex voice communications system between the PSACS1 system and any remote telephone, even one located in the public switched telephone network. The keyboard also allows for telephone calls to be answered.

The keyboard type AKB1 produces standard Dual Tone Multi Frequency (DTMF) tone signals compatible with most telephone systems (PSTN) and private networks (PAX). The AKB1 keyboard has twelve keys, 0-9, * and # in a standard telephone keypad layout. The keyboard connects to the four-wire PSACS1 network to derive its power and transmit the DTMF tones in response to key presses. The DTMF tones are transmitted via the V line to the pre-start alarm controller type APSA2 and then onto the surface via the coupler type ASCU, the surface pair and the surface barrier.

The actual operation of the keyboard and the key sequences to commence and end phone calls is dependent on the surface located phone system interface; therefore the operation of the keypad and the key sequences will be described in the phone line interface equipment manual and is beyond the scope of this manual.

KEYPAD TYPE AKB1 CONNECTION DETAILS			
#	COLOUR	NAME	PURPOSE
1	BLUE	R	POWER SUPPLY POSITIVE VOLTAGE 8 – 12V
2	YELLOW	V	AUDIO LINE – TRANSMIT DTMF TONES
3	RED	S	S LINE – NO CONNECTION TO AKB1
4	BLACK	M	POWER SUPPLY NEGATIVE – 0V

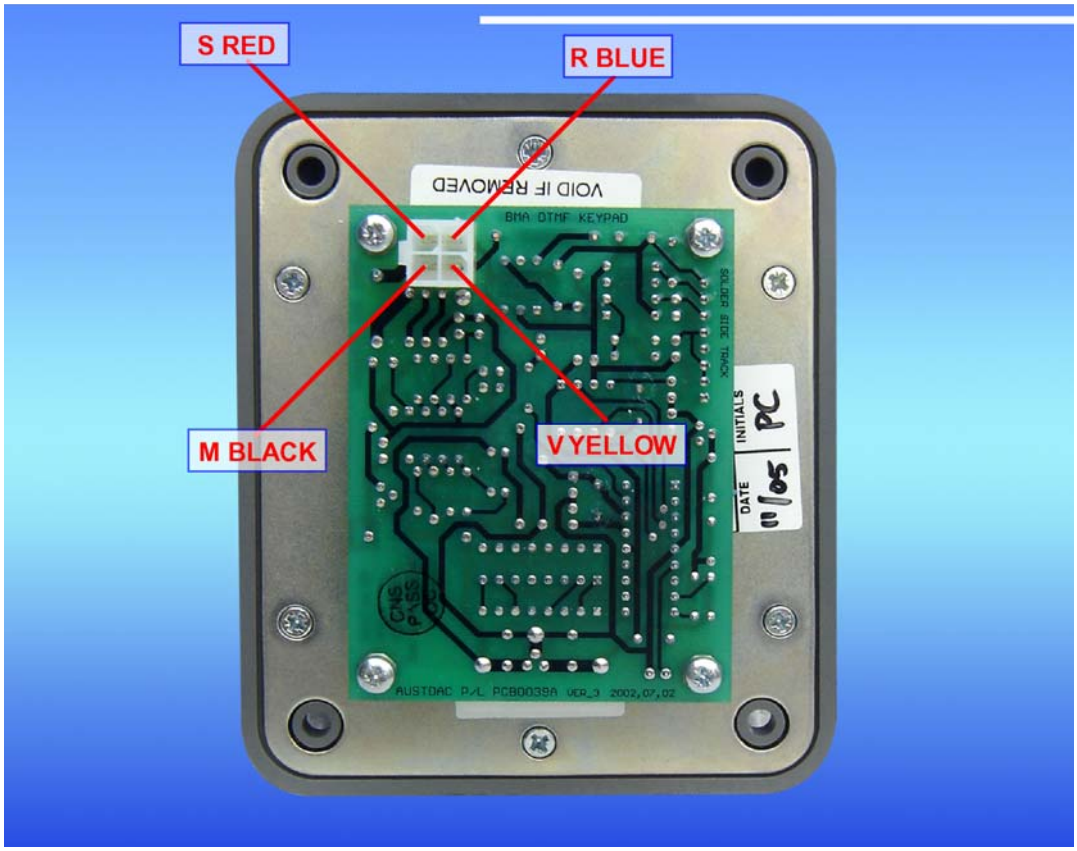
Table 9. Keypad type AKB1 connection details.

The keyboard is connected to the PSACS1 4 wire network via a four pin molex mini-fit jnr connector. The PSACS1 network wiring connections to this connector are shown in photograph 11 below.

The DTMF keyboard type AKB1 may be mounted within any suitable enclosure that provides a minimum IP55 ingress protection rating. The keyboard is typically mounted within a standard lockout enclosure or within a conveyor station enclosure along with a suitable intercom, such as the intercom type ABMA4. The actual enclosure will depend on the system design and functionality requirements.

The AKB1 keyboard is an optional device that is only required when direct dial facilities are required for the installation.

Photograph 17. DTMF keyboard type AKB1 front view



Photograph 18. DTMF keyboard type AKB1 rear view

15. COUPLER TYPE ASCU

The safety coupling unit type ASCU is used to provide DC galvanic isolation between the PSACS1 system and the surface pair. All voice signals and tones between the surface and the intercom string must pass via the safety-coupling unit. The safety-coupling unit allows the surface pair to be part of an Austdac telephone system multi-pair cable without compromising the intrinsic safety of either system.

A B
BARR007
SAFETY COUPLING UNIT
TYPE ASCU
AUS Ex 02.3254X Exia I
Ui = 12.6V Ii = 2.35A Uo =9.55V Io =503mA
Ci = 0uF Li = 0mH Co = 3.2uF Lo =1mH
MANUFACTURED BY AUSTDAC PTY LTD
SERIAL Nº 04051196
A B
COUPLER TYPE ASCU

Photograph 19. Coupler type ASCU front view.

The safety coupling unit type ASCU is completely encapsulated and contains no user serviceable components. The coupler is completely symmetrical and is not sensitive to polarity. The coupler has a coupling ratio of 1:1, an insertion loss of less than 2dB, characteristic impedance of 600Ω and frequency range of 300Hz to 4000Hz.

SAFETY COUPLER TYPE ASCU TERMINATION DETAILS			
PORT	PIN	FUNCTION	COLOUR
1	A	Voice frequency audio port with 600Ω characteristic impedance.	YELLOW
	B		BLUE
2	A	Voice frequency audio port with 600Ω characteristic impedance.	YELLOW
	B		BLUE

Table 10. Safety coupling unit type ASCU termination details.

16. SURFACE AUDIO BARRIER TYPE TIAB1

The audio surface barrier type TIAB1 is housed within a DIN rail mounting enclosure measuring 45mm x 75mm x 110mm. It is used to provide DC galvanic isolation and AC voltage and current limitation between the surface safe area and the surface pair from the underground-located PSACS1. All voice signals and tones between the surface exchange and the underground-located PSACS1 system must pass via the audio surface barrier. The audio surface barrier allows the surface pair to be part of an Austdac telephone system multi-pair cable without compromising the intrinsic safety of either system.

Photograph 20. Surface audio barrier type TIAB1.

The surface audio barrier type ASCU is completely encapsulated and contains no user serviceable components. The coupler is completely symmetrical and is not sensitive to polarity. The coupler has a coupling ratio of 1:1, an insertion loss of less than 2dB, characteristic impedance of 600Ω and frequency range of 300Hz to 4000Hz.

17. CERTIFICATION

The Pre-start alarm and communications system is covered by several AUS Ex certificates. Some items have individual certification but all are included in the system certification AUS Ex 02.3829X. Table 10 below shows the certification of all the PSACS1 system components.

PSACS1 PRE-START ALARM AND COMMUNICATIONS SYSTEM CERTIFICATION DETAILS			
NAME	TYPE	INDIVIDUAL CERTIFICATION	SYSTEM CERTIFICATION
PRE-START ALARM CONTROLLER	APSA2	AUS Ex 02.3110X	AUS Ex 02.3829X
INTERCOM	ABMA3	AUS Ex 01.3745X	AUS Ex 02.3829X
INTERCOM WITH DISPLAY	ABMA4	PENDING	AUS Ex 02.3829X
DAC BATTERY MINI AMP	STAGE II	MDA Exia 0544	MDA Exia 0544
TAIL END UNIT	TEU100	AUS Ex 02.3829X	AUS Ex 02.3829X
INTER-SYSTEMS COUPLER	ISC2	AUS Ex 02.3829X	AUS Ex 02.3829X
DTMF KEYBOARD	AKB1	AUS Ex 02.3829X	AUS Ex 02.3829X
SAFETY COUPLING UNIT	ASCU	AUS Ex 02.3829X	AUS Ex 02.3829X
SURFACE AUDIO BARRIER	TIAB1	PENDING	AUS Ex 02.3829X

Table 11. PSACS1 Pre-start alarm and communications system certification details.

The pre-start alarm system is also covered by IECEx certification TSA 07.0021X.